

Effect of Total Cold-Water Immersion Vs Ice Massage Modalities on Recovery after Exercise-induced Muscle Damage among Adults

Procedure

Participants were recruited by means of convenience sampling. A message was sent via WhatsApp for all the contact list of the investigators. This message included a brief explanation of the study purpose, phone numbers of the three investigators and a request to forward this message to the contact lists of the recipients.

At the beginning of the study, all participants' data were recorded, including their physical characteristics and eligibility, in addition to answering the questions of the PAR-Q.

Eligible participants were given information sheets and signed consent forms. Afterward, they were familiarized with the experimental procedure and given numbers in order to assure blindness during the processes of allocating them into groups and assessing the outcomes. Final participants included 60 eligible stratified into two blocks (30 males and 30 females).

Then a randomization website -website spreadsheet generator; <http://www.randomization.com> was used to randomly allocate each into one of two intervention groups: 1) Total CWI (TCWI) or 2) IM.

Baseline measurements of both groups (TCWI and IM) were taken and include 1RM, (2) CMJ, (3) VAS, and (4) Serum CK tests. Testing was followed by a warm-up session and then by muscle damage protocol. Thereafter, each of the interventions (TCWI or IM) were performed and followed by post-exercise measurements at 2; 24, 48 and 72 hours.

Muscle damage protocol. Muscle damage was induced by 20 sets of 5 drop jumps each, with a two-minute rest between sets. Participants were instructed to

drop jump from a 60-cm box, then perform a maximal bipodal CMJ, then land on the floor with knees flexed to at least 90°, while keeping their hands on their knees to eliminate additional force by upper limbs. This protocol produces a response similar to that obtained from high-intensity multi-joint exercises (Vieira et al., 2016).

Total cold-water immersion group. Participants allocated to the TCWI group completed a session of 15-minutes in cold water with a temperature of 12°C. Each Participant was totally immersed in a pool while his/her head and neck remained above water level. The water's temperature was continuously measured by a mercury-in-glass thermometer and maintained at the aforementioned temperature by continuously adding ice blocks.

With respect to depth of immersion, TCWI is more efficient than partial CWI since exposing a larger area of the body is needed for cardiovascular changes to occur (Murray and Cardinale, 2015; Stephens et al., 2016).

Ice massage group. Participants in the IM group were seated. The investigator in charge of this intervention group applied Ice cubes massage in a clockwise circular motion on the thigh area (quadriceps) for 15 minutes.

Data Analysis

The results were analyzed by the Statistical Package for the Social Sciences (SPSS) version 21.0 for windows. The Shapiro–Wilk test was used to check the normality of the data distribution. A probability (p) value of >0.05 indicates that there is no significant difference between groups.

Analysis of variance (ANOVA) test was used to compute the within-group differences of each variable (muscle damage, strength, power, and DOMS) at different testing times (Baseline, 2h, 24h, 48h and 72h after exercise).

Factorial repeated measures ANOVA test was used to determine between-group difference between TCWI and IM groups, of each variable (muscle damage, strength, power, and DOMS) at different testing times (Baseline, 2h, 24h, 48h and 72h after exercise).